COMMONWEALTH OF VIRGINIA

EASTERN SHORE COASTAL BASINS TRIBUTARY NUTRIENT REDUCTION STRATEGY

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Virginia Secretary of Natural Resources
Virginia Chesapeake Bay Local Assistance Department
Virginia Department of Conservation and Recreation
Virginia Department of Environmental Quality

EASTERN SHORE COASTAL BASINS TRIBUTARY NUTRIENT REDUCTION STRATEGY

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This Eastern Shore Coastal Basin Strategy has been produced through the efforts of a number of individuals representing state and local governments, agriculture, business, wastewater treatment plant operators, citizen groups and many others. The process was coordinated by the tributary Team Leader for the Eastern Shore Coastal Basins, Shawn Smith.

Thank you to those of you who participated in the process.

EXECUTIVE SUMMARY

The Eastern Shore of Virginia is an 80 mile long peninsula that encompasses about 696 square miles of land area with approximately ½ of this land area draining into the Chesapeake Bay. There are 17 localities within the Bay watershed of the Shore, including Accomack and Northampton counties and fifteen towns. The dominant land uses in the Bay watershed of the Shore are forest and agriculture, with several scattered industrial areas and denser development around the existing towns. Forest and agricultural land uses account for 90 percent of the land uses in the Bay watershed. Urban land uses are limited on the Eastern Shore and account for only 6 percent of the total land use.

The Eastern Shore is unique among the lower tributaries of the Chesapeake Bay because it is long and narrow, with numerous small watersheds that comprise a complex system of tidal creeks, guts and inlets. The majority of these creeks are primarily influenced by tides with limited freshwater flows in the upper reached. The water quality of these creeks are characterized by groundwater influx, nontidal baseflow, runoff from pulsed or storm-related events and Bay mainstem water.

Due to the number of small watersheds that comprise the Shore, the Chesapeake Bay Program's water quality monitoring and modeling efforts were focused on the Bay mainstem and did not include information for the local creeks. While there is data from state monitoring programs, the data currently is not sufficient to provide for living resource characterization, a focus of the tributary strategy process.

The development of the Eastern Shore Strategy began in March of 1998 when a kick-off meeting was held. Between March of 1998 and August of 1999, numerous meetings were held with the Eastern shore stakeholder group, comprised of Eastern Shore local government representatives, the Eastern Shore Soil and Water Conservation District representatives, the Virginia Cooperative Extension representatives, the Natural Resource conservation Service, point source operators, non-profit organization and private citizens. These stakeholders were instrumental in the development of this Strategy and will continue to be an important part of its implementation. In addition to local stakeholders, staff from several state agencies, such as DCR and DEQ, provided information and expertise in the development of this strategy.

The Eastern Shore stakeholders agreed to a long term living resource goal:

> *Increase the areas and density of Submerged Aquatic Vegetation throughout the Eastern Shore tidal creeks and embayments to historic levels to enable the return of abundant and diverse fish and shellfish populations which, in turn, will help to sustain and improve local economies.*

The Eastern Shore Strategy does not include long-term nutrient and sediment reduction goals which would achieve the above living resource goal at this time. The thrust of this strategy is in gathering local water quality information through enhanced water quality monitoring and small watershed modeling to determine the existing water quality issues and concerns on which to base a long term nutrient reduction goal. The Eastern Shore stakeholders did agree to work towards 2003 target reductions (page 37), which will provide additional nutrient and sediment reductions and which will be vital in determining future long term nutrient reduction goals. The Eastern Shore strategy will be re-evaluated in 2003, using information from the enhanced water quality monitoring and small watershed modeling efforts to develop a long term nutrient reduction goal to meet the living resource goal.

The Strategy includes recommendations for enhancing the water quality monitoring efforts to include five of the major creeks in the Bay watershed. It is hoped that this monitoring program will begin to provide better information on the condition of the local creeks. The Strategy also includes recommendations for acquiring better land use/land cover data to use in running a small watershed modeling program, the Tidal Prism Model, developed by VIMS. When better land use/land cover information is obtained, the Strategy recommends that the Tidal Prism Model or other water quality and/or SAV model be run on the same five creeks as the enhanced water quality monitoring efforts. At this time, additional parameters would be added to the water quality monitoring program to help the selected modeling program.

Finally, the Strategy includes 2003 nonpoint source nutrient and reduction targets (table on page 37) which, if implemented, could result in the reduction of an additional 120,700 pounds of nitrogen, 14,000 pounds of phosphorus and about 3,000 tons of sediment (beyond the 1997 projected reductions, page 31). These reductions will result in the following annual loads based on 1985 nonpoint source controllable loadings, pages 16-18):

Nitrogen	1,323,500 pounds;
Phosphorus	77,130 pounds; and,
Sediment	20,260 tons.

The Eastern Shore Soil and Water Conservation District has obtained a FY99 Water Quality Improvement Grant to hire an additional Agricultural Water Quality Specialist to assist in writing soil and water quality conservation plans in the Bay watershed. This effort will help towards meeting some of the targeted 2003 reductions. Cost estimates for the 2003 target reductions are about $2.8 million.

Point source reductions will be primarily achieved through nitrogen reductions from the industrial sewage treatment plant. Annual nitrogen reductions could range from 107,000 pounds to 113,000 pounds, resulting in annual point source nitrogen loadings of between 293,000 pounds to 300,000 pounds. The actual point source nitrogen reductions will be determined at a later time.

PART I. BACKGROUND AND INTRODUCTION

A TRIBUTARY STRATEGY PLAN FOR THE COASTAL BASINS OF VIRGINIA'S EASTERN SHORE

This is *Virginia's Tributary Nutrient Reduction Strategy for the Coastal Basins of the Eastern Shore of Virginia (Eastern Shore Strategy).* It sets forth actions that have been taken to date and actions that will be taken, to help Virginia citizens and government restore the water quality and living resources of the creeks in the coastal basin of the Eastern Shore. It also identifies additional information needs and solutions to best assess what additional practical, cost-effective and equitable methods are needed to reduce nutrient and sediment loads to the coastal basin creeks and the Pocomoke Sound. Tributary strategies rely on local decision-making and public participation to arrive at solutions tailored to the unique land uses, resources and characteristics of the basin.

This document is focused on the Bay watershed portion of the Eastern Shore. However, many stakeholders have expressed their desire to address the Atlantic Ocean watershed as part of this document. It is important to note that there currently is no modeling information addressing the Atlantic Ocean watershed on the Eastern Shore. While this document does not specifically address the Atlantic Ocean watershed, it is likely that similar conditions are present in this watershed. For this reason, the recommendations for nutrient and sediment reductions that are put forth for the Bay watershed would be equally important for the improving water quality in the Atlantic Ocean watershed.

Another important issue to discuss in this first section relates to *Pfiesteria piscicida* and the possibility of its presence in Virginia's portion of the Pokomoke River in August 1997. A modest menhaden fish kill of about 2,000 dead fish was discovered in late August 1997. In June 1997, the Commonwealth formed a state Pfiesteria Task Force, composed of scientists from state agencies and Old Dominion University to provide scientific guidance and a reasoned approach to the threat. The connection between water quality and outbreaks of *Pfiesteria piscicida* is still largely unknown due to the complexity of *Pfiesteria's* cycle. Until the science discovers the connection between the outbreaks of this organism and water quality, management actions to reduce the likelihood of *Pfiesteria piscicida* outbreaks will not be included in this document. Should research conclude that nutrient over-enrichment is one cause of these outbreaks, this document will be revised to discuss this issue in greater depth. The *Virginia Water Quality Assessment 305(b) Report, 1998* includes a good summary of what is known about *Pfiesteria piscicida*.

While not a primary focus of this document, unique agriculture operations should be taken into consideration during planning and implementation of the Eastern Shore Strategy. Some of these issues include poultry and plasticulture operations. The poultry producing agribusiness is a rapidly growing sector on the Eastern Shore. Poultry operations will need to be evaluated in terms of innovative technologies and methodologies to best implement nutrient management practices. Similarly, plasticulture crops are on the increase and while this agribusiness has proven beneficial to crop production and yields, with it comes the need for innovative conservation applications. This will also need further evaluation in order to identify the most effective pollution prevention and management practices available through current technology.

This *Eastern Shore Strategy* fulfills two commitments made by the Commonwealth of Virginia. The first commitment was made by the executive branch through former Governor Robb's signature of the 1983 Chesapeake Bay Agreement, and was reaffirmed through subsequent Bay Program Directives signed by former Governor Baliales in 1987, former Governor Wilder in 1993 and former Governor Allen in 1997. The second was made through the General Assembly's passage of tributary strategy legislation in 1996 (Article 2 of Chapter 5.1 of Title 2.1 of the Code of Virginia), which includes requirements and deadlines for tributary strategies for the eastern Chesapeake Bay coastal basins (the Chesapeake Bay watershed on the Eastern Shore of Virginia).

This tributary strategy is a plan that identifies some practical and cost-effective methods to reduce nutrient and sediment loads to the Eastern Shore coastal basins. Additional reductions were agreed to by the stakeholders provided funding is available. It also identifies additional local water quality monitoring and modeling for the local waters of the Eastern Shore. The goal of the strategy is to increase the areas and density of Submerged Aquatic Vegetation (SAV) throughout the Eastern Shore tidal creeks and embayments to historic levels which will enable the return of abundant and diverse fish and shellfish populations and will help to sustain and improve the local economies. This tributary strategy is based on the best available science, monitoring, computer modeling, local decision-making and the involvement of all citizens and interest groups that chose to participate. However, this strategy also notes that the best available monitoring and computer modeling does not necessarily accurately portray specific characteristics of the local waters of the Eastern Shore. For this reason, much of this strategy seeks to obtain better local water quality information through a more comprehensive and coordinated water quality monitoring program and through the use of a small watershed computer model. The foundation provided by the enhancement of these two data areas will ensure that additional solutions are tailored to the unique land uses, living resources and other characteristics of the Eastern Shore coastal basins. Implementation of tributary strategies is voluntary and activities consistent with this plan may be eligible for cost-share funding under Virginia's Water Quality Improvement Act.

Virginia's tributary strategy initiative began with the development of a strategy for the Shenandoah and Potomac River basins as part of the Chesapeake Bay Program effort to reduce the controllable nutrient loading into the mainstem of the Bay by 40 percent by the year 2000. This focus on the Potomac River basin stemmed from Bay Program computer modeling information, developed during a 1992 reevaluation, which showed that the nutrient loads from the Potomac River and all rivers north had substantial impacts on the Bay's water quality problems. This same modeling effort demonstrated that the nutrient loads coming from Virginia's lower tributaries, the Rappahannock, York and James and the eastern and western coastal basins, had much less of an impact on Bay waters. For this reason, the 40 percent commitment is only the interim goal for lower tributaries and will be replaced by a goal specifically focused on restoring living resources to the eastern coastal basin.

Since the 40 percent commitment is not the final goal to be applied to the lower tributaries, Virginia's *Eastern Shore Strategy* has been developed for the sole purpose of restoring habitat conditions in the Eastern Shore creeks and streams themselves. As with the 40 percent reduction goal for the entire Bay, the nutrient and sediment reduction objectives for the Eastern Shore coastal basin will be based on the results of computer modeling for the Chesapeake Bay as well as the small coastal basin watersheds.

The *Eastern Shore Strategy* is intended to be a somewhat fluid document and will be revised as additional information that can be used to best target nutrient and sediment reduction efforts becomes available. Because water quality monitoring and modeling information specific to the waters of the Eastern Shore is not yet available, long-term nutrient and sediment reduction goals have not yet been established for the basin. However, in the interim, stakeholders in the basin have determined a proposed mix of nutrient and sediment controls to be implemented by the year 2003 which will provide a strong foundation for meeting the nutrient and sediment reduction goals when established. Delays in the Chesapeake Bay Program's Tributary Water Quality Model (WQM) postponed setting final reduction goals for the lower tributaries, including the Eastern Shore coastal basin. However, once the results of the WQM became available, it was apparent that the Eastern Shore had no appreciable influence on the water quality of the Chesapeake Bay itself. Furthermore, it was noted that the WQM was unable to accurately portray the water quality issues of the small creeks and embayments of the Eastern Shore. Therefore, the Eastern Shore Strategy does not currently include final nutrient and sediment reduction goals, but does include recommendations for additional water quality monitoring and small watershed modeling so that stakeholders can identify cost-effective and beneficial practices to target nutrient and sediment reductions for improvements in local SAV beds. In addition, nutrient controls are already being implemented by citizens, local governments and businesses in the basin and stakeholders have identified additional BMPs that can be installed through voluntary actions, and through the use of available nonpoint source cost-share funds.

The *Eastern Shore Strategy* development process has already involved local governments, the soil and water conservation district, and many other citizens and stakeholders throughout the Eastern Shore. It is an ongoing process that will continue to be enhanced by local input, better scientific information, improved nutrient reduction technology and other factors.

Chesapeake Bay Program Goals

From its start with the *1983 Chesapeake Bay Agreement*, the federal-interstate Chesapeake Bay Program has targeted nutrient reduction as a principal means of restoring the Bay. Beginning with general statements of intent to improve the water quality and living resources of the Bay, the signatory jurisdictions refined their Bay clean-up efforts in the 1987

Chesapeake Bay Agreement. The 1987 Agreement included one of the most important and ambitious commitments of the Bay Program:

> "Develop, adopt, and implement a basin-wide strategy to equitably achieve by the year 2000 at least a 40 percent reduction of nitrogen and phosphorus entering the mainstem of the Chesapeake Bay. The strategy should be based on agreed upon 1985 point source loads and on nonpoint source loads in an average rainfall year."

This goal is intended to raise oxygen levels in the Bay's waters, which, in turn will help improve habitats and the health of living resources. The goal was reaffirmed following a reevaluation in 1992, and amended to bring a tributary-specific focus to the nutrient reduction effort, as well as adding the concept of "capping" the nutrient load at the reduced levels beyond the year 2000.

The 1992 reevaluation yielded an important finding about Virginia's tributaries and their impact on Bay water quality. It was determined that the nutrient loads from the Potomac and basins to the north had the greatest influence on conditions in the Bay, and the loads from the southern tributaries (Rappahannock, York, James and the western and eastern coastal basins) contributed little, if any to the dissolved oxygen deficit. For this reason, Virginia embarked on a two-pronged approach for our tributary strategies—a concentrated effort in the Potomac basin to meet the 40 percent goal, and simultaneously expanding the monitoring and modeling efforts in the lower tributaries to help determine appropriate reduction goals for each river and coastal basin.

The Chesapeake Bay Program has developed several water quality objectives that will be used in the development of strategies for each of Virginia's tributaries. These objectives will provide the primary scientific context in which nutrient reduction goals for each of the tributaries will be established. Water quality model simulations will be the basic technical tool used to help determine the nutrient reduction goals for each tributary.

The Problem of Nutrient and Sediment Pollution in the Bay and Nearshore Areas of the Eastern Shore Coastal Basin

Water quality in the Chesapeake Bay and its tributaries has been adversely impacted by nutrient over-enrichment. This is caused by excessive inputs of nitrogen and phosphorus (nutrients) which in turn can stimulate unwanted growth of algae. Algal blooms can shade SAV, and without the light needed for growth this important resource has difficulty surviving. If not eaten by higher life forms, the algae eventually sink and are decomposed by bacteria, a process that consumes valuable oxygen needed by fish, shellfish, and other bottom-dwelling aquatic organisms. The sources of these nutrient loads include runoff from urban and agricultural land, and treated discharges from municipal and industrial wastewater facilities.

Over the past twenty-five years, the Chesapeake Bay and its tributaries have been the focus of intensive environmental and ecological study. To understand the complex interactions between the Bay and its living resources, sophisticated computer models have been developed. These environmental and ecological studies, which have been verified by years of water quality monitoring in the Bay, have shown that nutrient over-enrichment is a significant water quality problem in the Bay and its tributaries.

In terms of this strategy, the water quality of the Chesapeake Bay and the local creeks of the Eastern Shore needs to be discussed separately. The water quality monitoring stations used by the Chesapeake Bay Program are located in the Bay mainstem and do not provide water quality information for the myriad of creeks and embayments that comprise the Eastern Shore coastal basin. Furthermore, most of the water quality monitoring of the lower portions of these creeks and embayments to date shows that the Bay water has more influence on the water quality of the lower tidal portions of these creeks than local water inputs. As indicated earlier, current water quality monitoring efforts on the local waters of the Eastern Shore have not yet identified any consistent results. However, it is still important to understand the nutrient and sediment inputs from the Eastern Shore as these inputs will have an impact on local water quality. Much of the following discussion relates to the water quality of the nearshore area of the Eastern Shore.

The capacity of the Bay to support living resources, including historically valuable SAV beds, is affected by increased levels of nutrients (nitrogen and phosphorus) and sediments. Excess nutrients in the Bay have led to increases in algae populations, which can adversely affect fish, oysters, crabs, underwater grasses and other aquatic life. The nutrients from the Eastern

Shore come primarily from nonpoint sources (about 75%), including surface runoff from farms, residential lands and other developed areas, and also from point sources (wastewater treatment plants). Another primary conduit for pollution on the Eastern Shore is groundwater inflow to the creeks and streams that bisect the shore. Groundwater inflow may contribute considerable fresh water to the creeks and streams because of the unique physical characteristics of the Eastern Shore which include high water tables and sandy soil (permeable soil). This strategy has focused more on the surface water runoff potential, but it is important to recognize the impacts of groundwater inflow on the water quality of the creeks and streams of the Shore. The impact of groundwater on water quality on the Shore should be more thoroughly investigated through other means.

Another important factor affecting water quality in the nearshore area is the amount of suspended sediment in the water column. High sediment concentrations can block the light needed by SAV, and may upset the feeding patterns of plankton and juvenile fish. When settled, the sediment can cover shellfish and hard substrate that they need for attachment and growth.

Objectives of the Eastern Shore Coastal Basin Tributary Strategy

A primary objective of the *Eastern Shore Strategy* process and final plan is to identify practical, cost-effective and equitable methods to reduce nutrient and sediment loads to target levels (reduction goals) in the coastal basins of the Eastern Shore. This will be done by providing the best available information on land uses, nutrient and sediment loads, water quality conditions and management practices to local decision-makers. The Strategy will then serve as an implementation guide for providing funding for identified nutrient and sediment controls. Given the lack of specific water quality data for the Eastern Shore coastal basins, this objective will not directly addressed at this time. When better water quality monitoring and modeling data become available, additional efforts will be made to meet this objective. A second objective is to inform citizens of the factors that affect the water quality of their creeks and streams, and identify ways they can help restore these waterways.

The Benefits of Reducing Nutrient and Sediment Loads

Even without the benefit of specific local water quality information, many benefits will accrue to the coastal creeks and streams on the Eastern Shore as a result of nutrient and sediment controls. The two most important are: 1) improving water clarity, necessary for underwater grasses; and, 2) increasing dissolved oxygen, essential for survival of all aquatic organisms. Increased levels of oxygen expand the volume of water available as habitat to aquatic organisms. Nutrient reductions also lead to vast improvements across the food web. Increased oxygen levels and water clarity improve conditions for benthic (creek bottom) organisms and small organisms (zooplankton) in the water column, which serve as food for fish. Underwater grasses provide habitat for invertebrates and juvenile fish, which also serve as important food for larger fish. Although nutrient and sediment reduction goals are not yet established, sufficient research and modeling has been done to demonstrate that further sediment and nutrient reductions will create benefits for the nearshore waters of the Eastern Shore.

Computer Modeling for Eastern Shore Coastal Basin Tributary Strategy Development

Much of the technical information that supports the *Eastern Shore Strategy* development comes from the estimates of nutrient and sediment loading levels for both counties on the Eastern Shore as estimated by the Chesapeake Bay Program Watershed Model (WSM). These numbers include the nutrient loads discharged from point sources in the basin and estimations of nonpoint source loading of sediments and nutrients from the different types of land uses on the Shore. These estimations provide a baseline for understanding status and trends of nutrient and sediment loads, and their relationship to water quality conditions in the nearshore area of the Shore. The WSM results serve as input to a second computer model, the Water Quality Model (WQM).

The Chesapeake Bay Program Water Quality (Bay Program WQM) computer model was used to help assess nitrogen, phosphorus, and sediment reduction goals for the Eastern Shore. It is important to note that the WQM model is not able to accurately reflect the water quality conditions of the numerous creeks and inlets along the Bay shoreline on the Eastern Shore. The Bay Program WQM results reflect larger nearshore areas (called cells) of the Bay itself that are adjacent to the Eastern Shore. The Bay Program WQM provides tributary-specific water quality simulations of the environmental benefits expected from varying levels of nutrient reduction for the other basins of the lower tributaries. The Bay Program WQM simulates the affects of nutrient enrichment—and the potential improvements from load reductions—in the cells that are adjacent to the Eastern Shore. The Bay Program worked for several years on enhancing the portions of the WQM that cover Virginia's southern tributaries. This was supported by enhanced monitoring completed in 1994, and this data was used to calibrate and verify the improved tributary Bay Program WQM. The Bay Program WQM was completed by mid 1999.

The Bay Program Water Quality model is a state-of-the-science model that has integrated links to other models, including:

- Watershed model;
- Airshed model;
- Hydrodynamic model;
- SAV (underwater grasses) model; and,
- Benthic model

This integrated model is capable of simulating the water quality responses that can result from a wide range of management options. This model will provide information on where the most cost-effective nutrient reductions can be made and the benefits associated with these reductions.

The most recent versions of the model now test the Bay's response to not only changes in dissolved oxygen, but investigate its impact on a variety of living resources such as the critical nursery grounds for many important Bay finfish and shellfish. In addition, it includes not only their habitat, but also potential food sources for a number of the Bay's important fishes. These and other aspects of the Tributary Water Quality Model will be useful in determining the level of nutrient and sediment reductions that would benefit the coastal basins on the Eastern Shore.

The Bay Program WQM is not an appropriate tool for use in the goal setting process for Virginia's coastal basins, including the Eastern Shore. The basins along the eastern and western shores are small with shallow depths and their features fall well below the resolution for the Bay Program WQM to simulate with any degree of reliability. In addition to the Bay Program modeling, the Virginia Institute of Marine Science has developed a water quality model that can be applied to the small coastal basins on the western and eastern shores. The Tidal Prism Model seeks to address the deficiencies noted above by simulating the smaller scale of the creeks, inlets, and embayments that dot the western and eastern coastline. The Tidal Prism Model focuses on tidal flushing which is the primary factor in the dynamics of Virginia's small coastal basins. The principles behind the Tidal Prism Model are similar to the Bay Program's WQM, in that the nutrient and sediment loadings are derived from land use types and amounts.

The Tidal Prism Model includes the following general inputs:

- Basin geometry and tidal range
- Water quality (boundary)conditions in the Bay at the mouth of the subject basin
- Point source loadings
- Land Use/Land Cover data
- Watershed Model

Since it was not practical to test the Tidal Prism Model on all of Virginia's small coastal basins, four target basins were selected. In 1997, the Tidal Prism Model was tested on the Poquoson River and the Piankatank River on the western shore and Hungars Creek and Cherrystone Inlet on the Eastern Shore. Before the model could be evaluated for use in tributary strategy development in the coastal basins, additional monitoring data was needed for calibration. Water quality monitoring was conducted in each basin for one year, beginning in 1997. The findings of the monitoring for the creeks on the Eastern Shore showed only a trend of increased total suspended solids which exceeded SAV requirements in both creeks.

The model results are satisfactory in terms of carbon, nitrogen and phosphorus for Hungars Creek; however, model results for the other three basins and other basins on the Eastern Shore will need more accurate nonpoint source loadings of nutrients and sediments. Data for calibration of the watershed model to the specific Eastern Shore watersheds are required if this particular model is to have further applications to these small coastal basins. Based on the results of Hungars Creek, it appears that the Bay water quality has more of an influence on the water quality of the tidal portion of these creeks than the freshwater inputs. The one exception is the pulsed inputs after storm events, which causes spikes of nutrients and sediments to occur in the creeks. These spikes are quickly diluted in the tidal portions of the creeks. While the Tidal Prism Model does not yet have refined enough nonpoint source inputs (Land Use/Land Cover) to supercede the Bay Program WQM, its initial results provide some additional insight into the specific conditions of the small coastal basins. In the future, this model should be used in conjunction with the Bay Program WQM to better characterize the small basins. Acquisition of better Land Use/Land Cover which will appropriately characterize the nonpoint source inputs to the Tidal Prism Model is an integral part of this strategy and will be discussed in greater depth later in this document.

The Shenandoah/Potomac Experience: Lessons Learned

In 1994, we began the development of tributary strategies by instituting a partnership among state government, local governments, interest groups and stakeholders in the Shenandoah and Potomac river basins. At the state level, scientific data and technical assistance was provided to support this process. Local governments were asked to bring their experience to the table and to represent the interests of their constituents in the decision-making involved in the strategy development process. Citizens and other stakeholders were asked to contribute their expertise and innovative thinking on how to devise practical, cost-effective and equitable solutions for reducing nutrient loadings.

We learned much from our local partners in this process. One of the most important messages heard was that further water quality initiatives in Virginia must not be handed down as unfunded mandates. Local governments, farmers and others across the Shenandoah and Potomac basins stated that all Virginians benefit from cleaner water and that we all should bear some part of the costs for achieving it. As we finalized the Shenandoah and Potomac River Basins Nutrient Reduction Strategy, former Governor Allen kept faith with this local guidance by proposing $11 million for strategy implementation beginning in 1997 as well as $60 million for the current biennium. Additional funding for strategy implementation was made available by Governor Gilmore and will be discussed in the next section.

From our local partners, we also learned that protecting the quality of local rivers and streams themselves must be considered as important as protecting downstream waters such as the Chesapeake Bay. This combination of a local perspective and the big picture of Bay restoration is a valuable approach to the management of our water quality programs, including monitoring. First, every cleanup effort that is accomplished at the local level will have a positive impact on downstream water quality; and, in fact, we will only achieve restoration of the Chesapeake Bay as a cumulative result of those local and individual actions. Second, our monitoring program must be able to recognize localized areas of water quality concern, as well as portray the overall health of the Bay system. This approach will enable us to better target limited resources to areas that will most benefit from them.

Water Quality Improvement Act Fund

The purpose of the Virginia Water Quality Improvement Act of 1997 (Act) is to restore and improve the quality of state waters and to protect them from the impairment and destruction for the benefit of current and future citizens of the Commonwealth (Section 10.2-2118). Because this is a shared responsibility among state and federal governments and individuals, the Act also creates the Water Quality Improvement Fund (Fund). The purpose of the Fund is to provide Water Quality Improvement Grants to local governments, soil and water conversation districts and individuals for point and nonpoint source pollution prevention, reduction and control programs....(Section 10.1-2128). The Department of Environmental Quality has the responsibility to provide technical and financial assistance to local governments and individuals for the control of point source pollution. The Department of Conservation and Recreation (DCR) has the responsibility to provide technical and financial assistance to local governments, soil and water conservation districts, and individuals for nonpoint source pollution prevention, reduction and control programs.

A primary objective of the Fund is to reduce the flow of excess nutrients to the Chesapeake Bay through the implementation of the Bay Tributary Strategies as well as reductions of nutrients to other waters of Virginia. The 1998 Virginia General Assembly provided funding for three regions of the station in the 1998-2000 biennium, through the general appropriation act. The three regions are the Shenandoah-Potomac Basin, the lower Bay tributaries (which includes the Eastern Shore coastal basins) and the Southern Rivers region. The Atlantic Ocean watershed is eligible for competitive grants through the

Southern Rivers region. Funding for the Fund for the FY 2000 budget includes over $3.6 million in new money and more than $1.5 million in interest.

Grants will be continue to be competitively awarded for water quality improvement projects for the lower Bay tributaries. These projects should focus on implementing components of the tributary strategies. A ranking of projects will be established based on criteria as outlined in the grant application. Nutrient reduction potential and cost effectiveness will have priority.

For point source projects, all the funds will be targeted to facilities located in the Shenandoah-Potomac Basin in order to meet the Commonwealth's commitment to achieve a nutrient reduction of 40 percent by the year 2000. After the year 2000, additional money will for reductions of point sources in the lower Bay tributaries will be available. The General Assembly also directed that any additional funds deposited into the Water Quality Improvement Fund during the biennium be used for nutrient removal projects in Virginia's lower tributary basins.

Except for specific requirements noted in the general appropriations act, the Secretary of Natural Resources (SNR) is charged with annually allocating money between point and nonpoint sources. The SNR also establishes the allocation of nonpoint source funds between the Agricultural Cost-Share Program and the competitive grant projects. The SNR's annual funding allocations are subject to public review and comment period, a public hearing, and are accomplished in consultation with the Directors of the Department of Conservation and Recreation, the Department of Environmental Quality and the Chesapeake Bay Local Assistance Department. The public review process for the the proposed allocation of funds for the FY2000 WQIA funds will likely occur in the summer of 1999 with applications submitted in the Fall of 1999 and awards to be made in December 1999.

The Eastern Shore Soil and Water Conservation District received a WQIA grant in FY1999. This grant was for $64,996 and was used to hire an additional Agricultural Water Quality Specialist to write an additional 120 soil and water conservation plans. This project is matched by $37,092 from the ESWCD. The work completed by this grant will help to further reduce nutrients and sediments in the Bay watershed. The additional reductions will be discussed in later sections of this document.

For further information on the Fund, please refer to the *Annual Report on the Virginia Water Quality Improvement Fund Nonpoint Source Program, Senate Document no. 21.*

PART II. EASTERN SHORE COASTAL BASIN WATER QUALITY AND LIVING RESOURCES

The Eastern Shore is an 80 mile long peninsula that contains about 696 square miles of land area that lies at the southern tip of the Delmarva peninsula on the eastern shore of the Chesapeake Bay. The Shore is bounded by the Chesapeake Bay on the west, the Atlantic Ocean on the east, and the state of Maryland on the north. Approximately half of the Eastern Shore's land area drains into the Chesapeake Bay. As a peninsula, the Eastern Shore is unique among the basins in Virginia. There are no rivers draining to the Bay from Virginia's Eastern Shore. The major river draining into the Chesapeake Bay from the Delmarva peninsula, the Pocomoke River, is located mainly in Maryland. The Pocomoke Sound does lie partially in Virginia.

The Eastern Shore is long and narrow, with numerous small watersheds that comprise a complex system of tidal creeks, guts and inlets. Tributaries on the Eastern Shore that drain into the Bay are Onancock, Pungateague, Occohannock and Nassawadox creeks as well as numerous smaller creeks such as Old Plantation Creek, Kings Creek, Hungars Creek, Cherrystone Creek, Pitts Creek, and Holdens Creek. The tidal portions of these creeks are generally deeper and wider at their mouths and can be extremely shallow further inland. The freshwater portions of these creeks can be very shallow and narrow and the watersheds of the coastal creeks are small, particularly when compared to the watersheds of the lower Bay rivers. The creeks and streams that flow into the Bay are tidally influenced and therefore, have a more direct connection to the waters of the Bay. The fact that the much of the creeks are primarily tidally influenced presents unique problems for the Eastern Shore as the water quality of the Bay itself has as much influence on the health of the tidal portions of the creeks as other inputs. The water quality within the tidal creeks are influenced by nontidal baseflow, direct groundwater discharge, runoff from pulsed or storm-related events, and bay mainstem water.

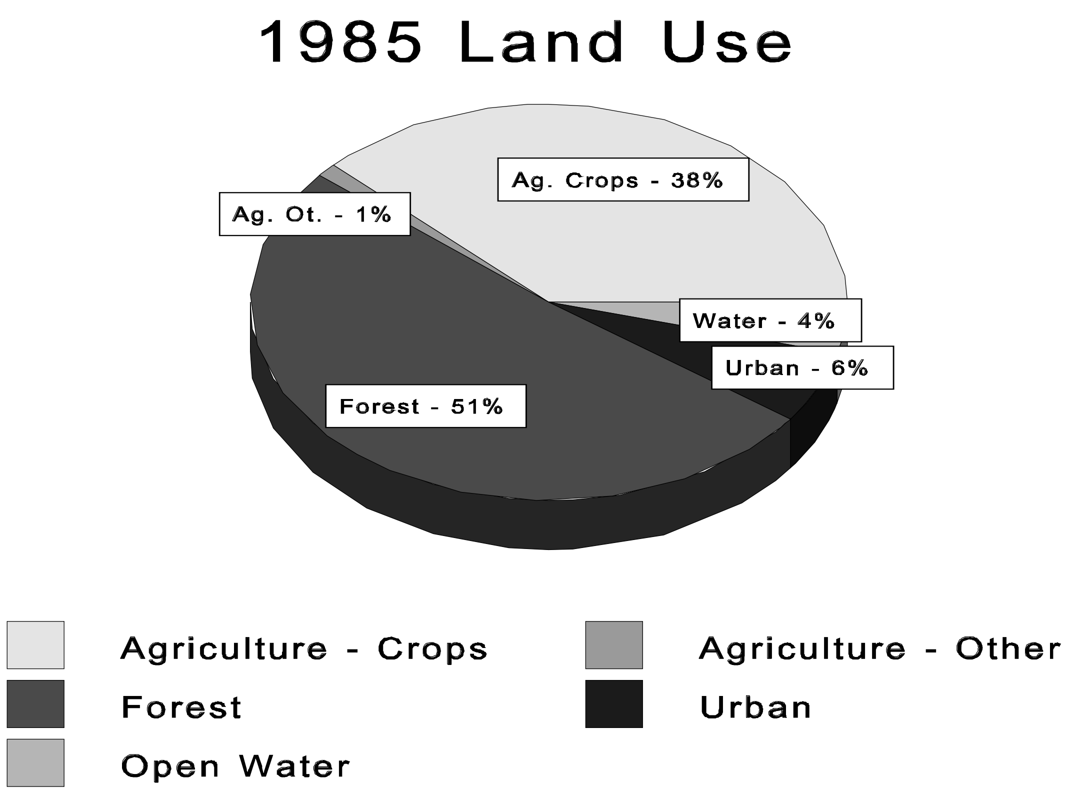
The climate for the Eastern Shore is moderate and influenced primarily by the Atlantic Ocean. The annual average temperature is 58° F, with recorded extremes in temperature in excess of 100° and -5°. The Eastern Shore lies wholly within the Coastal Plain Physiographic Province which is characterized by average elevations of no more than a few feet above sea level and most slopes of less than or equal to two percent. The central spine of the Eastern Shore has more significant elevation and forms a plateau about 45 feet above sea level. Soils on the Shore are predominately sandy loam resulting in rapid infiltration of water and dissolved materials. Because of the shallow water tables and minimal slopes and elevation, most soils reach saturation quickly and surface runoff occurs after modest rainfall events. The average rainfall is about 43 inches with wide variations in the monthly rainfall due to the influence of the Atlantic Ocean. The yearly rainfall resupplies the shallow and the deep groundwater aquifers which are the sole source of drinking water for Shore residents.

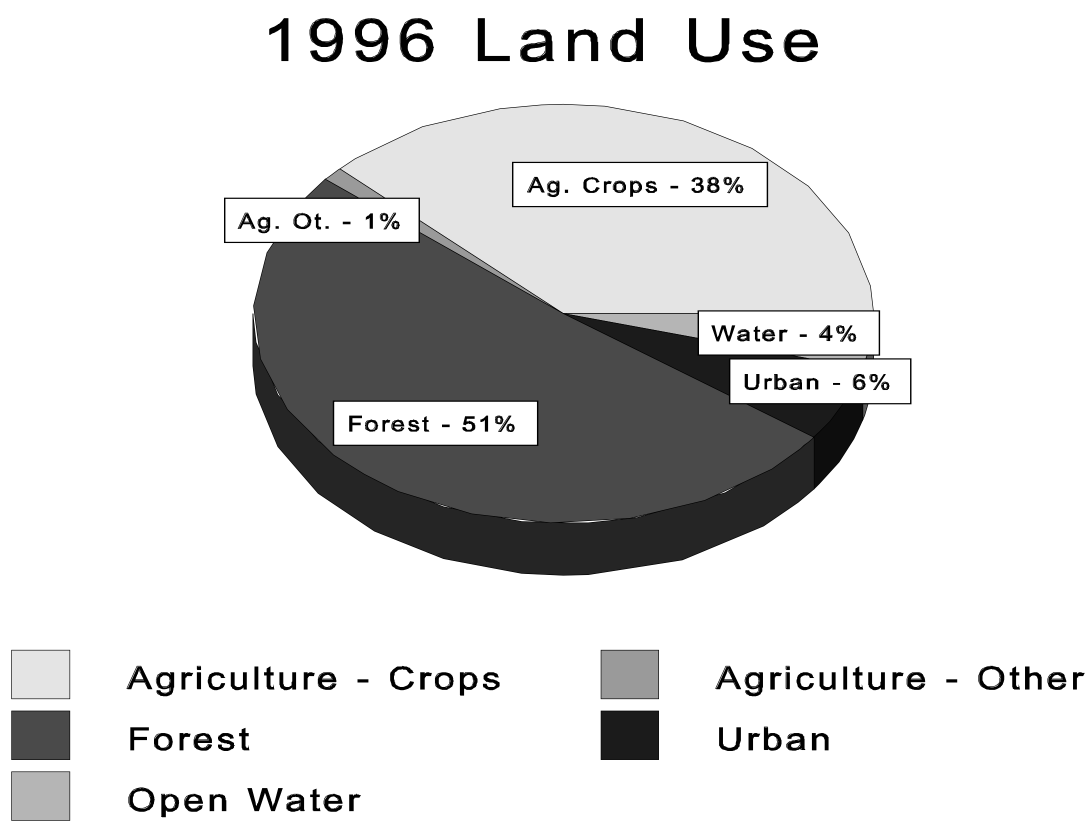
The existing water quality data for the Eastern Shore creeks is somewhat limited due to the number of creeks and streams that dissect the Shore and the number of monitoring stations that lie within these creeks. The data that are available appear to indicate that water quality in the creeks is generally good, with the most likely limiting factor with respect to living resources being sediment (total suspended solids or TSS). This is not to say that the creeks themselves would not benefit from reduced levels of nitrogen and phosphorus as these nutrients may be contributing to the elevated TSS levels in the creeks.

There are 17 localities in the Bay watershed of the Shore, including Accomack and Northampton counties and fifteen towns. The population for the Eastern Shore as a whole is around 45,000, with about half living in the Bay watershed. There are no urban areas on the Eastern Shore, and most people live in largely rural settings. Accomack County has a little more than twice the population and land area of Northampton County. Residential and commercial development on the Eastern Shore is not expected to increase dramatically, but the potential for increased development pressure exists. Currently, there are plans to develop a large residential and golf course complex in the Cape Charles area and this type of development may occur more frequently in the future.

Eastern Shore Coastal Basin Land Uses and Loads

The Eastern Shore coastal basin remains largely rural and undeveloped. The dominant land uses are forest (51%) and agricultural (39%) land uses which account for about 90 percent of the land use in the basin. Of the agricultural land uses, crops account for nearly all of the land use, with nearly 95 percent of the agricultural land use. In addition to the forest and agriculture land uses, there are scattered industrial areas and pockets of development in and around the existing towns. Urban land uses are limited on the Eastern Shore, and account for only 6 percent of the total land use. For the Shore, urban land uses are generally characterized by the commercial development along the Route 13 corridor and the development in and adjacent to the towns on the Shore.


1985 Land Use
Ag. Crops - 38%
Ag. Ot. - 1%
Water - 4%
Urban - 6%
Forest - 51%
Agriculture - Crops
Agriculture - Other
Forest
Urban
Open Water



The total load of nutrients and sediments that enter the coastal basins on the Eastern Shore comes from nonpoint sources or point sources (nutrients discharged from municipal and industrial sewage treatment plants). The two major categories of nonpoint sources are runoff from agricultural land and runoff from urban land.

There are four sewage treatment plants which have permitted flows of at least 0.10 MGD in the Bay watershed on the Shore. One of these is an industrial STP (Tyson Foods, Inc.), while the other three are minor municipal STPs which serve the towns of Onancock, Cape Charles and Tangier. Of these four plants, three are in Accomack County (Tangier, Onancock and Tyson Foods, Inc.) and the Town of Cape Charles STP in Northampton County. While there are several other small sewage treatment plants on the Shore, these four have a large enough volumes to require a permit with the Department of Environmental Quality. The following table provides an overview of the flow characteristics of these four sewage treatment plants, comparing 1985 flows to 1996 flows.

Sewage Treatment Plant Flow Characteristics - 1985 - 1996

Facility	Avg. Flow (MGD)	TN Conc. (MG/L)	TN Discharg. (Lbs/Yr)	TP Conc. (MG/L)	TP Discharg. (Lbs/Yr)
Tyson Foods, Inc.	1985 - 0.80	113.91	277,400	1.15	2,801
	1996 - 0.83	148.47	377,512	20.43	51,947
Onancock STP	1985 - 0.11	18.70*	6,300	6.40*	2,143
	1996 - 0.22	18.70*	8,500	2.50*	1,877
Tangier STP	1985 - 0.06	18.70*	3,400	6.40*	1,169
	1996 - 0.09	18.70*	5,100	2.50*	672
Cape Charles STP	1985 - not online				
	1996 - 0.17	18.70*	6,300	2.50*	1,259

* Default value - average concentration for sampled secondary treatment facilities in Virginia (no monitoring data available for this facility)

According to the May 1997 303(d) report on impaired waters, two creeks in Accomack County have elevated fecal coliform levels, although their priority for Total Maximum Daily Load (TMDL) development is low when compared to other waters in Virginia. Both impaired creeks drain into the Pocomoke Sound.

The Eastern Shore Coastal Basin includes 8 hydrologic units, delineated for the purposes of watershed management and water quality planning. The nonpoint source pollution potential assessment performed by the Department of Conservation and Recreation (part of the 1998 305(b) report) resulted in the following rankings of the 8 watersheds:

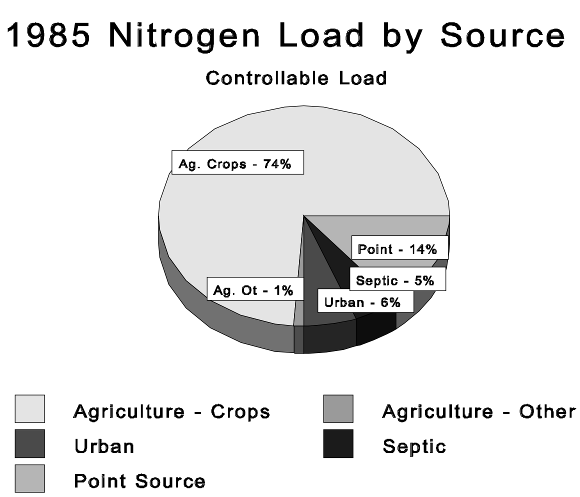
- six (C09, C12-C16) have a "high" potential for pollution from agricultural activities;
- one (C15) is listed as having a "high" potential for total nonpoint source pollution

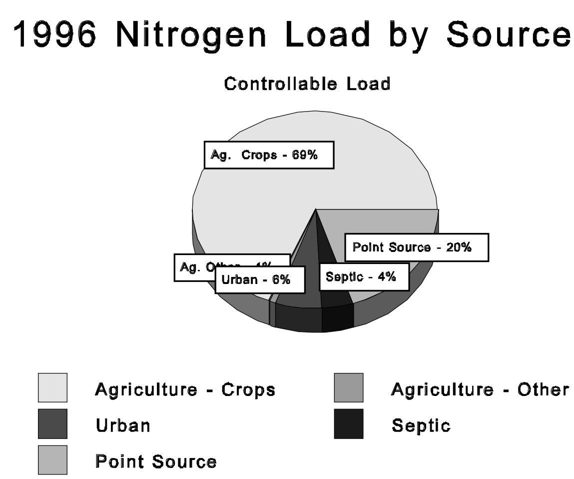
The numbers provided in the Strategy for nutrient and sediment loadings are based on the Chesapeake Bay Program's Watershed Model. The Watershed Model uses information on the land use coverage of the 64,000 mile drainage area to compute nitrogen, phosphorus, and sediment runoff from the land. It then inputs the loads discharged by wastewater treatment plants and "delivers" the total load to the Bay. The Watershed Model relies on weather data, land use data, soil and geophysical data, and point source load estimates to calculate the total nutrient and sediment load reaching the Bay.

The Bay Program participants established the year 1985 as the baseline from which all nutrient and sediment reductions, occurring due to the implementation of Best Management Practices (BMPs) would be calculated. The baseline nutrient load is the sum of 1985 point source discharges and the nonpoint nutrient runoff, associated with 1985 land uses in the Eastern Shore coastal basin, calculated for an average rainfall year. Estimates of nutrient and sediment loads calculated by the Watershed Model are designed to provide data that is unaffected by yearly changes in rainfall. Based on data for land use, loading rates/acre, population density, point source loads and transport factors, the Model has calculated total, estimated nutrient and sediment loads to the Eastern Shore coastal basins for 1985 and 1996. In addition, the model has been used to calculate the relative point source loads and nonpoint source loads from major land use types for the two counties in the basin. Watershed Model nutrient loading charts for the years between 1985 and 1996 for the basin are included in the following pages. The breakdowns for the two counties are provided in Appendix A.

Not all of the nutrients entering the Bay are considered to be controllable. The nonpoint source loads that naturally occur from forested areas in the basin are not considered to be part of the controllable fractions. The remaining nutrients, both from point and nonpoint sources, that enter the Bay are considered to be “controllable” to some degree and can therefore be reduced through nutrient reduction practices. The charts that follow represent loading fractions which are considered to be “controllable” for the purposes of strategy development and calculations of potential reductions.

Nitrogen. In the base year of 1985, agricultural crops were the largest contributor of controllable nitrogen loads in the coastal basin accounting for 74% of the total controllable nitrogen load. Point sources were the second largest contributor, with 14 % of the controllable load coming from point sources. Urban land uses and septic systems contributed 6% and 5% respectively with other agricultural activities only adding about 1%. In 1996, the controllable nitrogen load from agricultural land uses had been reduced by 5 percent and accounted for 69% of the total controllable load of nitrogen. Point sources increased the percentage of controllable nitrogen by 6 percent to 20% of the total controllable load. Urban land uses continued to contribute 6% of the load, while the percentage of the nitrogen load from septic systems was reduced by 1 percent to 4% of the total controllable load. The increase in point source loads is attributed to increased flow by the introduction of 2 new STPs between 1985 and 1996.





Changes from 1985 - 1996 Nitrogen Loads by Source

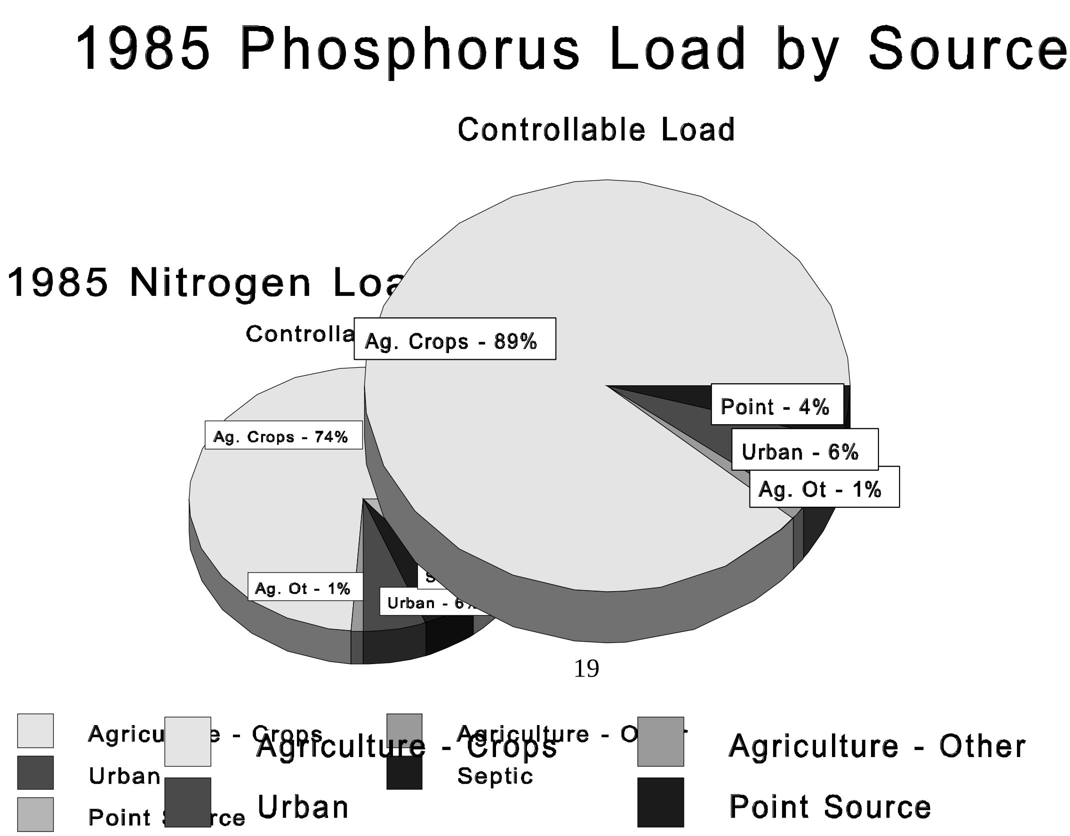
Eastern Shore Coastal Basin

Controllable Loads

	1985	1996	Change	
Agriculture - Crops	1,469,799 lbs.	1,433,784 lbs	-36,015	-3%
Agriculture - Other	26,627 lbs.	23,429 lbs.	-3,198 lbs.	-12%
Urban	117,883 lbs.	117,410 lbs.	-473 lbs.	-<1%
Septic	91,349 lbs.	90,886 lbs.	-463 lbs.	-<1%
Point Source	287, 080 lbs.	405,995 lbs.	118,915 lbs.	+41%
TOTAL	**1,992,739 lbs**	**2,071,503 lbs.**	**+78,764 lbs.**	**+4%**

Notes: Agriculture - crops includes conservation tillage and conventional tillage as well as hayland.
Agriculture - other includes pasture and animal waste.
These numbers were provided by the Department of Conservation and Recreation and are based on the watershed model of the Chesapeake Bay Program.

Phosphorus. In the base year 1985, agricultural crops were the largest contributor of controllable phosphorus loads at 89 percent in the Eastern Shore coastal basin. Urban land uses and point sources accounted for 6 percent and 4 percent respectively, with other agricultural land uses (poultry waste acres and pasture lands) contributing around 1 percent. In 1996, agricultural crop land remained the largest contributor of controllable phosphorus at 65 percent, while point sources increased to 30 percent of the load. The increase in the controllable phosphorus load from point sources is attributed primarily to a change in the processing of the sewage effluent at the industrial STP, rather than an increase in flow. In 1985,



the industrial STP treated its effluent with the chemical alum which precipitates out phosphorus and by 1996, the STP was no longer using alum in its sewage treatment. Urban land uses (4%) and other agricultural uses (1%) contributed the remaining amount of controllable phosphorous. The other increase in phosphorus occurred in the other agricultural category and can be linked to an increase in the number of poultry operations in the watershed.

Changes from 1985 - 1996 Phosphorus Loads by Source

Eastern Shore Coastal Basin

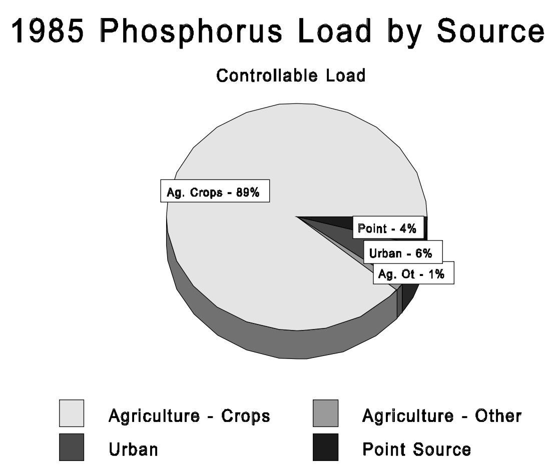
Controllable Loads

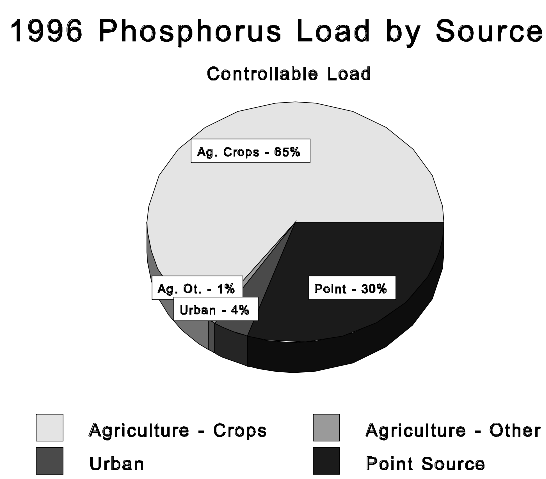
	1985	1996	Change	
Agriculture - Crops	122,871 lbs.	119,716 lbs.	-3,155lbs.	-3%
Agriculture - Other	1,056 lbs.	1,405 lbs.	+349 lbs.	+33%
Urban	7,762 lbs.	7,727 lbs.	-35 lbs	-1 %
Point Source	6,113 lbs.	55,755 lbs.	+49,642 lbs.	+812%
TOTAL	**137,802 lbs.**	**184,603 lbs.**	**+45,967 lbs.**	**+33%**

Notes: Agriculture - crops includes conservation tillage and conventional tillage as well as hayland.
Agriculture - other includes pasture and animal waste.

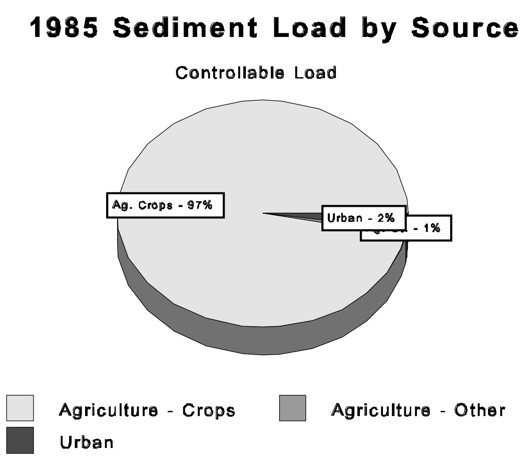
These numbers were provided by the Department of Conservation and Recreation and are based on the watershed model of the Chesapeake Bay Program.

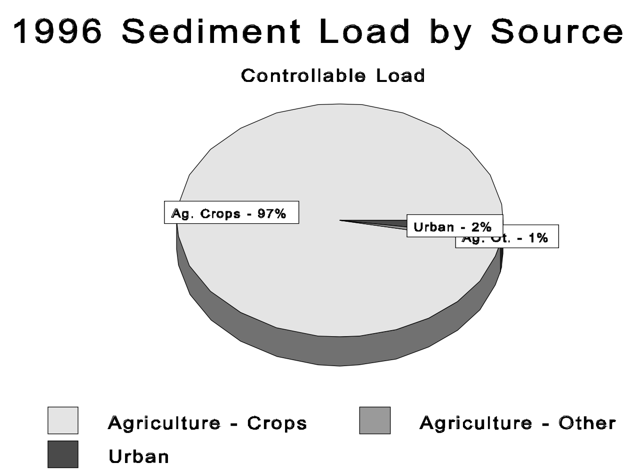
Sediment. In the base year of 1985 and again in 1996, agricultural crops contributed nearly all of the controllable sediment load at 97 percent. Urban land uses accounted for about 4 percent with other agricultural land uses contributing around 1





percent in both years. While there was essentially no change in the percentage of contributing land use categories, sediment loads were reduced by 6 percent due to reductions in the amount of controllable sediment from agricultural crop land.





Changes from 1985 - 1996 Sediment Loads by Source

Eastern Shore Coastal Basin

Controllable Loads in tons

	1985	1996	Change	
Agriculture - Crops	28,692 tons	26,970 tons	-1722 tons	-6%
Agriculture - Other	101 tons	101 tons	No change	
Urban	755 tons	754 tons	-1 ton	-<1 %
TOTAL	**29,549 tons**	**27,826 tons**	**-1,722 tons**	**-6%**

Notes: Agriculture - crops includes conservation tillage and conventional tillage as well as hayland.
Agriculture - other includes pasture and animal waste.

These numbers were provided by the Department of Conservation and Recreation and are based on the watershed model of the Chesapeake Bay Program.

During March of 1998, fifty top scientists in the Mid-Atlantic region who study water quality and living resources were convened at the Virginia Institute of Marine Science to bring together their combined research and knowledge of the status and trends of the Rappahannock, York and James river basins as well as the western and eastern coastal basins. These scientists determined that the Eastern Shore suffers from increased loadings of sediments and phosphorus, and further that there are no monitoring data available characterizing the Eastern Shore's phytoplankton, zooplankton, and benthic communities. Much of the information presented in this section are excerpts of the information collected, researched and discussed at that meeting.

Water quality and living resource monitoring results are expressed as a comparison between Chesapeake Bay tributaries. The status of such parameters as water clarity, plankton, zooplankton, benthic, and submerged aquatic vegetation are expressed as good, fair, or poor as compared to other Bay areas. This comparison does not necessarily mean that a basin meets all of the requirements for living resource restoration. Rather, it does provide a relative comparison with similar ecosystems in the Bay watershed.

In the following discussion of water quality, the terms “good”, “fair”, and “poor” are often used to describe current status. These are statistically based on classifications developed for making comparisons to other areas within the Chesapeake Bay system. Many scientific studies have shown that the current Chesapeake Bay system has excessive and detrimental levels of nutrient and sediment pollution. Thus the terms of “good”, “fair”, and “poor” are not an absolute evaluation of status but rather a statement relative to other areas of a generally degraded system. If these status evaluations compared current nutrient and sediment pollution levels of the Eastern Shore coastal basin to those found in the basin 100 years ago, most statements regarding status would likely use the term “poor”.

Water Quality Monitoring Overview

The Department of Environmental Quality (DEQ) participates as a key member in the Federal-Interstate Chesapeake Bay Monitoring Program. This monitoring program is an important component of the scientific basis to demonstrate that Bay restoration efforts are having a positive impact. While DEQ has monitoring stations in several creeks on the Eastern Shore, currently there is no comprehensive or coordinated water quality monitoring effort on the Shore that can provide data on local water quality trends.

The major component of this monitoring focuses on water quality. This component monitors key abiotic qualities of the water such as nutrient concentrations, water clarity, salinity levels, dissolved oxygen concentrations and pH. The DEQ monitors these parameters monthly at 65 locations throughout the Bay mainstem and tidal tributaries (i.e. tidal portions of the James, Rappahannock, York, and Elizabeth rivers). Currently there are 20 monitoring stations in 11 creeks in the Bay watershed on the Eastern Shore. Ten of these 20 stations were installed in Onancock Creek in 1998 and trend analysis for these stations cannot be determined at this time.

The DEQ also provides guidance to, and receives monitoring data from, the Alliance for the Chesapeake Bay (ACB). Volunteers for the ACB have been monitoring water quality since 1985. This program is administered under the guidance of the Monitoring subcommittee to the Implementation Committee for the Interstate Chesapeake Bay Program. In Virginia, stations have been established on the James, York, Rappahannock, Piankatank, Potomac, Lynnhaven and Elizabeth rivers, as well as the Chesconessex Creek on the Eastern Shore. The parameters tested are air and water temperature, Secchi disk depth (turbidity), total depth, salinity, pH, dissolved oxygen (DO), ammonia, precipitation, field observations of water conditions and color, weather, and general conditions of the site. At five ACB monitoring stations in Virginia, samples were taken for inorganic nutrients (nitrate, ammonia, nitrite, and ortho-phosphate) in addition to their standard parameters.

Eastern Shore Coastal Basin Water Quality Monitoring: Status and Trends

There are over 60 named creeks, gut, and branches in the Bay watershed on the Eastern Shore. The majority of these creeks have little flow beyond the influence of tidal waters. Of these 60+ creeks, monitoring occurs on 23 sites on 12 creeks. Appendix B includes a map showing the location of the existing DEQ monitoring stations on the Eastern Shore. Additional monitoring was undertaken for a year in one of the creeks monitored by DEQ and one previously unmonitored creek by VIMS as part of the Tidal Prism Model test. The results of this monitoring will be included in this section as well. Due to the limited amount of monitoring data available for the Eastern Shore's creeks, it is difficult to determine status and trends for the entire Eastern Shore basin, particularly with respect to SAV parameters. The results of the current and previous monitoring do appear to indicate that there may be some general trends relative to water quality which could be true for the remaining creeks. However, it is the opinion of the participants in the strategy development process that a primary focus of the strategy should be the development of a comprehensive water quality monitoring program for the Eastern Shore so that in the future, nutrient and sediment reduction efforts can best be targeted to address specific water quality problems.

The water quality on the 12 creeks is monitored in several ways, and these are distinguished by the parameters that are measured. Biological monitoring usually refers to sampling of organisms such as bottom-dwelling (benthic) invertebrates, fishes, or algae, that inhabit the waterbody. This approach is most appropriate for detecting aquatic life impairments and assessing their severity.

Ambient monitoring refers to the measurement of physical or chemical parameters, such as dissolved oxygen, pH, temperature, heavy metals, nutrients, etc. This type of monitoring can be useful not only in assessing the health of a waterbody, but can help to identify specific stress agents that are causing an impact as well as the sources of these agents. Parameters measured in the Eastern Shore creeks that are specifically related to tributary strategy development include: dissolved oxygen, total Kjeldahl nitrogen (TKN), ammonia, nitrate, nitrite, total phosphorus and orthophosphorus, suspended solids, turbidity, Fecal Coliform and Chlorophyll *a*.
Biological and ambient water quality monitoring in the creeks on the Eastern Shore basin are performed by DEQ, Old Dominion University, Virginia Institute of Marine Science and citizen groups, specifically the Alliance for the Chesapeake Bay. All of these data are compiled and presented by the DEQ in the 303(d) Total Maximum Daily Load Priority Lists (TMDL) and 305(b) Water Quality Assessments.

For the purposes of this document, the monitoring data from the creeks and from the Bay mainstem will be presented. The mainstem information is being presented because the water quality of the Bay impacts the water quality of the tidal creeks and in order to present as clear a picture as possible, should be included. Figure 2 in Appendix B shows the location of the stations (CB7PH) that are discussed in the following section.

Tidal Fresh and Tidal Water Quality

The absence of strong trends in nutrient and sediment loads complicates the interpretation of water quality data and living resource responses. Results of the status and trends analyses should be interpreted with caution. Although the status of most parameters were good, the observed patterns do not necessarily reflect the results of management actions, particularly since the monitoring stations are located in so few of the tidal creeks on the shore. In addition, some parameters exhibited trends indicative of degrading conditions.

Nitrogen. Status of nitrogen total and dissolved inorganic nitrogen was good for the mainstem of the Bay closest to the Eastern Shore. There were no trends in nitrogen or total dissolved nitrogen in the Bay mainstem through 1997. Status of nitrogen was good for all creeks sampled, including SAV habitat requirements. Data from various studies indicated everything from low inorganic nitrogen levels, to increased nutrient levels after storm events. The data gathered does not yet show any clear trends in nitrogen levels in the monitored creeks. However, additional reductions in nitrogen through point and nonpoint source controls should result in improvement in the ambient conditions of the creeks.

Phosphorus. Status of total phosphorus for the mainstem of the Bay was good closest to the Eastern Shore. Degrading trends in surface dissolved inorganic phosphorus were detected in the Eastern Virginia Chesapeake Bay area after the addition of the 1997 data. Status of phosphorus showed no clear trends in terms of phosphorus levels, with few instances of high phosphorus levels in the samples taken. SAV habitat requirements in terms of phosphorus were met in all instances. However, additional reductions in phosphorus through point and nonpoint controls should result in improvements in the ambient conditions of the creeks.

Algae. Chlorophyll is an indicator of algal levels. Status of chlorophyll *a* was good in all segments of the mainstem closest to the Eastern Shore and no trends were apparent. Status of chlorophyll *a* as it relates to SAV requirements was generally fair, with algae concentrations noted in late winter and early spring in two creeks. However, the spatial distributions of these concentrations either showed no pattern or decreasing concentrations from the creek mouth inland into the creeks which suggests that the winter-spring algal bloom originates from the Bay. The data provides no clear trends in algal levels or Chlorophyll *a* levels.

Water Clarity. Status of water clarity was fair in all segments of the mainstem closest to the Eastern Shore. Degrading trends in Secchi disk depth were detected in all segments of the Virginia Chesapeake Bay in 1996 and persisted after the addition of the 1997 data. Status of water clarity was not monitored in other creeks with the exception of Chesconessex Creek which showed a decreasing Secchi depth, indicating impaired water clarity. The lack of improved water clarity and the reduction of water clarity in at least one of the creeks should be of concern since water clarity is important for SAV habitat.

Suspended Solids. Status of suspended solids was fair in all segments of the mainstem closest to the Eastern Shore. Degrading trends were detected in the Eastern Virginia Chesapeake Bay area in 1996 and continued after the addition of the 1997 data. Levels of total suspended solids (TSS) concentrations exceeded the SAV habitat requirement in at least 3 monitored creeks in all seasons. Total suspended solids in two of these creeks showed either no spatial pattern or a pattern of increasing concentrations landward into the creeks from the creek mouth, suggesting that runoff contributes to excess suspended solids concentrations. Reduction of suspended solids will be important to improving the ability of SAV to grow and increase in the creeks.

Dissolved Oxygen. Status for dissolved oxygen was good in all mainstem segments that are closest to the Eastern Shore and no trends were detected in data collected in 1996 and 1997. Other monitoring showed no areas of concern with respect to dissolved oxygen, with either very few samples showing DO violations, or no samples showing violations. One study, completed in 1992 and based on a one year study, did note some DO problems in the 3 Bayside creeks, but no other monitoring stations showed any recent DO problems. As with most other parameters, there is no clear trend in DO levels for the creeks that have been monitored. However, additional reductions of nutrients and sediments will help to ensure that DO levels will not become problematic.

Eastern Shore Coastal Basin Living Resources: Status and Trends

The DEQ Bay Monitoring program focuses on the status of ecologically important noncommercially biological communities. The DEQ monitors these communities as a sub-set of the water quality stations so that the analysts can study and understand the linkages between water quality and biological communities. Benthic communities (i.e. bottom dwelling invertebrate organisms) are monitored semi-annually at 21 fixed locations and once each summer at 100 randomly allocated stations. Planktonic communities (i.e. small plants and animals in the water) are monitored at 14 stations and more intensively in fish spawning areas.

The Virginia Marine Resources Commission (VMRC) conducts two programs involved in the collection of fisheries information in the Bay. The Commercial Fisheries Harvest Reporting program assembles data on commercially valuable species harvested from Virginia waters and nearby oceanic waters. Harvest or landings of over 50 species taken by dozens of fishing methods are analyzed on a monthly basis. These data are used to develop conservation and management strategies and to determine the benefits and impacts of proposed measures.

VMRC's Stock Assessment Program collects information concerning the biological attributes of various fish populations. These data are, in turn, used in population models to assess the health of the resource and the impacts of various levels of fishing. However, additional data on finfish populations are needed.

Effective fisheries management is currently dependent upon reliable and timely measures of the level of harvest and the ability to detect significant changes in the fish populations. VMRC's Harvest Reporting Program and Stock Assessment Program assists in this management. Information from the program is used as a basis for fishery management decisions at the state, inter-state, and federal levels. The quality of the data ensure that decisions affecting Virginia's fishing population will be based upon good science.

In general, the limited amount of monitored data appears to suggest that the living resources in the Bay watershed creeks may be limited by total suspended solids and to some extent, excessive nutrients. This hypothesis is developed from evidence available for SAV habitat parameters.

The Chesapeake Bay Agreement states that the productivity, diversity and abundance of living resources are the best ultimate measures of the Chesapeake Bay's condition. These living resources are the ultimate focus of the restoration and protection efforts. Another point to consider in trying to evaluate the status of living resources is that restoration of degraded communities often takes better water quality than what would be required to maintain resources. In other words, water quality may be sufficient in some creeks of the Eastern Shore to maintain existing resources but could be insufficient to restore already impaired living resources.

There is no monitoring data available characterizing the Eastern Shore basin's phytoplankton, zooplankton, and benthic communities. However, these living resources will be discussed using information that pertains to the mainstem of the Bay, as with the water quality information in the previous section.

The following summarizes the most recent information on the status of Virginia shellfish, finfish and other living resources.

Benthos. Benthic communities are the bottom dwelling organisms living in or on the sediments at the bottom of the Bay. They are a food source for many fish and waterfowl species and are sensitive overall indicators of the Bay's health. Their populations can be affected by both toxic contaminants and low dissolved oxygen levels.

One station in the Bay close to the Eastern Shore met the goals for benthos and others close to the Shore showed no major differences. This same station showed improving trends in benthos community composition. No information on benthos is available through monitoring for the creeks on the Shore.

Phytoplankton. Phytoplankton communities are microscopic plant organisms that form the base of the Bay's food web. The status of phytoplankton was good at all stations close to the Eastern Shore. In the Bay mainstem near the Eastern Shore, there are both improving and degrading trends in terms of phytoplankton, depending on where in the water column the sampling occurred. Therefore, a clear trend is difficult to discern.   No information on phytoplankton is available through monitoring for the creeks on the Shore.

Zooplankton. Two of the stations in the Bay mainstem close to the Shore showed zooplankton communities below minimal and degrading trends were noted in zooplankton abundance and diversity at both of these stations between 1996 and 1997. Overall however, no significant trends were noted for the mainstem as a whole between 1996 and 1997. No information on zooplankton for the creeks on the Shore is available through monitoring.

Submerged Aquatic Vegetation (SAV). Underwater grasses, known as Submerged Aquatic Vegetation (SAV), are recognized as a key biological indicator of the Bay's health. Populations of SAV have been intensively monitored since 1978. They have increased throughout the Bay by 72 percent since 1984 but are still well below levels known to have been present as recently as the 1960's. Their complete recovery continues to be inhibited by poor water quality in many areas.

Virginia's eastern Chesapeake Bay is one of two regions in the lower Chesapeake Bay that has abundant SAV, the other being Mobjack Bay. Most of the resurgence of SAV in the entire Chesapeake Bay since 1985 has occurred in the Virginia portion of the Bay. SAV acreage in the Eastern Shore area of the Bay, from the southern tip of Tangier Island south to Fisherman Island, declined slightly in 1995, and rose slightly in 1996. SAV was mapped along most of the whole Bay shoreline of the Eastern Shore in 1996 with the exception of the area south of Elliot's Creek. There was SAV in the mouths of most of the other creeks, but its extension further into the creeks was limited.

Scientists at VIMS used aerial photography and archives to evaluate the location of SAV beds in Eastern Shore creeks. They determined that nearly all 65 creeks on the Eastern Shore had SAV to depths of up to 6 feet and extending about 25 percent further up the creeks than existing SAV beds today. The SAV was primarily eelgrass with some widgeon grass in the shallows.

However, the SAV beds in the Pocomoke Sound are nearly absent and SAV areas in Tangier Sound have declined 50 percent since 1992. The impacts of the Eastern Shore on these two areas has not yet been established through monitoring and more information should be gathered to best target restoration efforts for these areas. Hydrologic modeling data appear to indicate that the waters from the Potomac and above have more of an impact on the water quality of Tangier Sound that the lower tributaries, including the Eastern Shore. Likewise, the amount of land area that drains to the Pocomoke Sound from Virginia may limit the Eastern Shore's ability to increase SAV beds in the Sound. Additional water quality monitoring information will be helpful in determining the limiting factors for these two areas.

While the water quality for SAV growth was generally good with all SAV habitat requirements either being met or borderline in all years, the total suspended solids habitat requirement was not met in 1995. However, the data showed significant worsening trends in three of the SAV parameters: light attenuation, total suspended solids, and dissolved inorganic phosphorus. These three parameters were up significantly in 1996 and if the trends continue, more SAV habitat requirements will fail in the future. One focus of this Plan should be to better target water quality monitoring and modeling efforts to determine the likely causes of the SAV losses and gains in the interior portions of the Eastern Shore creeks so that nutrient and sediment reduction efforts can be focused where they are likely to have the best results.

According to the current tributary water quality conditions relating to the five SAV habitat objectives based on the *Second Annual Report on the Development and Implementation of Nutrient Reduction Strategies for Virginia's Tributaries to the Chesapeake Bay, 1997*, SAV habitat objectives were met for all five parameters.

Fisheries. Bay anchovies are small fish that feed on microscopic animals called zooplankton that float in the water. Bay anchovies have declined and this may be caused by a decline in the food resources. Menhaden, small fish that feed on phytoplankton, microscopic plants that float in the water, are also declining. The absence of both a clear trend and information relating to phytoplankton makes the development of a hypothesis to explain these two trends very difficult. One suggestion that has been put forth relates to changes in the pattern of phytoplankton availability which may have impacted other fish in the food web.

Striped Bass. Striped bass continue their recovery beyond historically high levels and now support healthy commercial and recreational fisheries. However, findings of low body weight in adult fish may signal a lack of traditional food sources.

Migratory Fish. Spring runs of American shad, hickory shad, blueback herring, and alewife in the Bay are currently depressed. It is believed that the decline in these fish is the result of obstructions to traditional spawning areas as well as other causes.

Blue Crab. Recent levels of abundance of the Chesapeake Bay adult blue crab population have been average in comparison to long term (1956 - present) levels, but lower than the very high abundance of the 1980's. At the same time, recent harvests (1994-96) have been lower than average levels of the last 20 years. Historical information indicates a long-term shift in the blue crab population abundance caused by tropical storm Agnes in 1972. Studies by VIMS suggest the storm caused a dramatic loss of sea grass (SAV) habitat and food for the blue crab within the Chesapeake Bay. With the expansion of sea grasses since 1972, similar increases have occurred in juvenile blue crabs, but not adult crabs. Future improvements in levels of abundance and harvest can occur quickly.

Oysters. Populations of oysters, which provide great economic and ecological benefits to the Bay region, are very low. Reasons for the decline have been related to historic over fishing, habitat degradation, poor water quality, and more recently, oyster diseases.

Waterfowl. Virginia is enjoying the rebound of many Atlantic Flyway duck populations, allowing the state to expand the duck season to sixty days and liberalize bag limits. On the other hand, the migratory Canadian goose population has shown a precipitous decline largely due to over-harvest and poor reproductive success. However, biologists are confident that the implementation of sound management techniques, such as the current season closure, will restore populations as they were restored in the Mississippi Flyway in recent years. The resident goose population continues to increase in Virginia.

Status and Trends Summary

In general, the lack of specific information for the creeks in the Bay watershed of the Eastern Shore and the use of relative indicators for comparison of conditions among tributaries, does not help in providing a clear picture of the water quality concerns of the Eastern Shore creeks. In fact, the only discernable trend is in total suspended solids, which are generally increasing and generally tied to runoff from land uses in the particular watershed. While the water quality of the Shore creeks may be generally good, there has not been enough monitoring to truly paint a complete picture of these creeks. Furthermore, reductions in nutrients and sediments will not only help the quality of surface water, but groundwater, upon which the entire Eastern Shore depends for its potable water. The only living resource parameter that has the potential for trend analysis would be the loss of many of the smaller SAV beds from the interior portions of some creeks on the Shore. As discussed in subsequent sections, monitoring should be focused on several major creeks in both counties of the Eastern Shore, some of which appear to have experienced a loss of interior SAV beds.

PART III. ASSESSMENT OF BASIN NUTRIENT ISSUES, PROGRESS AND CONTROL OPTIONS

The Eastern Shore Coastal Basin is still rural in nature, with most land either forested (51%) or used as agricultural crop land (38%). Water features account for an additional 4 percent and urban land uses account for 6 percent. Nonpoint sources dominate the basin, meaning that most of the nutrient reduction efforts that will be undertaken on the Eastern Shore will need to emphasize the management of pollution through the use of Best Management Practices (BMPs) on agricultural and urban lands. Point source reductions are not likely to be as significant a part of the final Eastern Shore strategy to reduce the nutrient "gap" as they will be in other more point source dominated basins, such as the Potomac and Shenandoah Basin. The major point source on the Eastern Shore is a private facility, the Tyson Foods, Inc. Sewage Treatment Plant (STP) and will be undertaking some nutrient reduction efforts which will be discussed later in the document. While there will be some growth in public point sources, it is not anticipated their amount of growth will have a great deal of effect on the nutrient loading for the Shore. These point sources may be important in maintaining the achieved reductions as growth does occur.

Growth on the Eastern Shore is fairly steady, with much of the growth occurring as single family residential growth as well as some additional commercial growth along the Route 13 corridor in both counties. As with other rural areas in the state, there is a trend towards conversion of agricultural land and forest land to more urban land uses, including residential development. Urban land uses, in the context of the Eastern Shore, is a relative term and can include residential, commercial and industrial development. While large scale development has not yet occurred on the Eastern Shore, a 2,000+ acre residential golf course development (Baycreek) is poised to begin construction in the Cape Charles area. This type of large scale development may occur more frequently on the Shore in the future as growth pressures increase from the north of the Shore. Many of the Shore's new residents are retirees from the northern states.

Overall, point source loads are a relatively small portion of the nutrient load in the Bay watershed on the Eastern Shore (as a proportion of the total load), particularly when looking at the public point sources. The only public point source that is expected to have an increase in flow is the Cape Charles STP which will have flow increases as a result of the development of Baycreek. However, there are no flow projections are available at this time for the Cape Charles STP. In addition, there is the possibility in the future that one or more new public STPs may be constructed around existing towns. These new STPs will likely have limited flows similar to the existing public plants and will replace a number of existing onsite septic systems.

ASSESSMENT PROCESS

Stakeholder Tributary Initiatives

Given the nonpoint focus of the *Eastern Shore Strategy*, the Eastern Shore Soil and Water Conservation District, the Virginia Cooperative Extension Offices and the Natural Resource Conservation Service all played an important role in the identification, evaluation, and recommendation of BMPs that are effective in reducing nutrients and are practical and cost-effective. To date, these groups have played a very vital role in facilitating dialogue during the strategy development process. Their role will continue to be important as the Eastern Shore Strategy is refined and implemented given the fact that much of the possible nutrient and sediment reduction actions are agricultural BMPs.

The Department of Conservation and Recreation (DCR) is the lead state agency for addressing nonpoint source pollution (NPS). To this end, DCR will be responsible for assisting these stakeholders in the implementation of the NPS components of this strategy. Further, DCR, among other agencies and organizations will provide the necessary support to the stakeholders to ensure efficient effective implementation.

The Accomack-Northampton Planning District Commission (ANPDC) assisted in the coordination of the strategy development process through meeting scheduling and follow-up. The ANPDC continued to provide assistance through the goal setting process and should help facilitate additional education efforts as the strategy begins to be implemented.

The Eastern Shore Strategy Development Process

The *Eastern Shore Strategy* kick-off meeting was held on April 9, 1998 and was well attended. Among those in attendance were state and local government officials and staff, Eastern Shore Water Conservation District personnel, Natural Resources Conservation Service staff, Virginia Agricultural Extension agents, as well as members of the Citizens for a Better Eastern Shore and other private citizens. This meeting provided an overview of the existing conditions for the Eastern Shore as provided by the watershed model as well as a discussion of how the strategy development process would be undertaken. Staff from the Department of Conservation and Recreation provided an overview of the Chesapeake Bay Program Watershed and Water Quality Model development. At that time, it was expected that the Chesapeake Bay Program Water Quality Model would have results by late Summer or early Fall, 1998. However, this deadline was not met and the Water Quality Model is currently being run to produce some results. The delay in the development and use of the Bay Program Water Quality Model is due primarily to the complexity of the technical issues related to the model, including the addition of a refined air deposition load, the addition of a septic load, and a refinement of the land use base to develop nonpoint source loadings. One result of the Kick-Off meeting was the refinement of the amount of agricultural cropland under conservation tillage, which in turn represented a reduction in the existing nutrient and sediment loadings. The agricultural stakeholders were able to provide information to better reflect the actual conservation versus conventional cropland and the land uses were refined accordingly.

A series of assessment meetings were held with staff of both counties and stakeholders representing the agricultural community during early May, 1998. These meetings were held to develop an assessment of current and planned actions that impact nutrient and sediment levels in the Eastern Shore basin.
A second meeting was held with stakeholders on May 28, 1998 to review basin nutrient and sediment loading information, Bay Program modeling development information and review of nutrient and sediment reductions to date based on the assessment meetings. At this meeting, the group also discussed the additional steps that needed to be undertaken to complete the development of the strategy.

On September 10, 1998, stakeholders met with the Team Leader and with Dr. Arthur Butt from the Department of Environmental Quality who provided an overview of the water quality modeling efforts to date as well as the work towards development of the Tidal Prism Model. Dr. Butt provided attendees with some preliminary results of the water quality model runs. He also provided the group with an overview of the Tidal Prism Model development as it relates to the Eastern Shore.

At the next meetings, held on October 1, 1998 and October 30, 1998, stakeholders began to identify additional nutrient and sediment reductions as part of a regional nutrient reduction scenario. In developing the scenario, stakeholders were asked to identify additional BMPs that they felt could be implemented if additional resources (money and/or staff) were made available. The time frame that was selected was five years (to the year 2003), as this represented a reasonable timeframe for planning purposes. Revisions to this Strategy will likely include projections out to the year 2010 as this is the proposed date for meeting the goals for the lower tributaries. Given that it is near the end of 1998, no projections were made for the year 2000 as it was recognized that additional resources would not likely be made available until then. The BMPs that the stakeholders selected are all related to agricultural land uses, as these land uses represent the largest contributors of nutrients and sediments. Furthermore, the stakeholders felt that these BMPs would be the most cost-effective on a per pound reduced basis. It is important to note that these reduction levels have not been modified to reflect increases in the nutrient load due to increases in point source flow and land use conversion (both of which are anticipated to occur as population increases).

After the meetings in late Fall of 1998, another series of meetings were held in late Winter and early Spring of 1999 to discuss the results of the Bay Program's Water Quality Model runs. At the request of the stakeholders, several WQM runs were completed which held all other tributaries at the 1996 reduction levels and the Eastern Shore at several higher nutrient reduction levels. The results of these model runs indicated that additional reductions from nutrient and sediment loads from the Eastern Shore would have a relatively minor, but positive effect on the density of SAV in the Bay along the mouths of the Eastern Shore creeks. Model scenarios showing significantly greater nutrient and sediment reductions from the upper Bay tributaries (Potomac River and above) also show significantly greater improvements in the density of SAV beds in the Tangier and Pocomoke Sound areas.

The results of the WQM provided no information on the improvements in the SAV beds in the local creeks that were due to the additional reductions. Furthermore, there is no current data indicating the limiting factors for SAV in the creeks. Stakeholders reviewed the various model scenarios and discussed the scenarios as possible nutrient and sediment reduction goals. However, the stakeholders ultimately decided against setting any nutrient and sediment reduction goal beyond the year 2003 reductions at this time as they agreed that additional information on the conditions of the local creeks is crucial to responsible goal setting and nutrient reduction efforts. Instead, stakeholders believed that, at this time, the strategy should focus on improving water quality monitoring and water quality modeling for the creeks with an emphasis on educating citizens and others of the importance of water quality. Stakeholders also agreed to continue working towards the 2003 nutrient and sediment reductions outlined on page 37 and to participate in a re-evaluation of this in 2003 providing at that time there is better water quality monitoring and modeling information to use in setting a long term nutrient and sediment reduction goal. Stakeholders expressed their desire for any long-term nutrient and sediment reduction goal to the be the most cost effective and equitable means of improving water quality and SAV in the local creeks.

Therefore, it also appears likely that the development and maintenance of basin tributary strategies will need to be an ongoing process into the future as growth occurs, loads change, and resource conditions change.

Nutrient Reduction Efforts to Date as a Measure of Progress

Basin stakeholders in conjunction with the Tributary Team Leader, worked closely to evaluate the levels of BMP implementation during the period of 1985 through 1996-97. One of the major tasks was to review the information about BMP installation tracked through existing state programs and to confirm and reconcile this information with BMP installations known to stakeholders but not state program managers. This exercise also included an evaluation of what standard BMPs were being implemented as this was an important element in determining the nutrient reduction of these activities. The table on the following page reflects the work of the stakeholders for the entire Eastern Shore basin. Individual county information is provided in Appendix A.

Nonpoint Source BMPs for Eastern Coastal Basins (Chesapeake Bay Basin)

Based on Implementation of Current Programs (via State Program Tracking Information and Stakeholder Input)

		Year 1997 Progress		*Reductions (lbs or tons per year)*		
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Sediment
Farm Plans	acres	41,894	46.5%	75,947	23,122	6,605
Nutrient Management	acres	10,367	11.9%	46,821	2,183	0
Agricultural Land Retirement	acres	123	0.1%	2,171	182	43
Grazing Land Protection	acres	0	0.0%	0	0	0
Stream Protection	acres	0	-----	0	0	0
Cover Crops	acres	3,042	3.6%	20,019	798	216
Grass Filter Strips	acres	1,804	-----	54,552	5,350	1,319
Woodland Buffer Filter Area	acres	0	-----	0	0	0
Forest Harvesting	acres	1,174	70.0%	6,014	77	77
Animal Waste Control Facilities	systems	0	-----	0	0	0
Poultry Waste Control Facilities	systems	11	-----	2,897	222	0
Loafing Lot Management	systems	0	-----	0	0	0
Erosion & Sediment Control	acres	42	81.7%	3,604	129	39
Urban SWM/BMP Retrofits	acres	No data	0.0%	0	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	0
Septic Pumping	systems	1,383	-----	639	0	0
Shoreline Erosion Protection	linear feet	15,058	-----	28,690	18,864	328
			Total Pounds/Tons Reduced:	241,352	50,927	8,626
			Adjustment for Land Use Changes:	(20,085)	9,610	2,264
			Adjusted Reduction:	261,437	41,317	6,363
			Nonpoint Controllable Amount:	1,705,659	132,523	29,549
			Percent Reduction:	15.3%	31.2%	21.5%

Evaluation of Various Water Quality Model Scenarios

Stakeholders evaluated several Water Quality Model Scenarios as part of their assessment process. Among those they evaluated was the the interim 40% goal for the reduction of nitrogen and phosphorus that was set for the lower Virginia Tributaries as part of the 1992 Bay Program re-evaluation process. The Interim Bay Agreement goal translates into a 34 percent reduction of nitrogen, a 33 percent reduction in phosphorus and a 27 percent reduction in sediment. Data from watershed model Limits of Technology (LOT) and Maximum Feasible Limits of Technology (now referred to as Full Voluntary Implementation) were presented to the stakeholders in April, 1999. These runs looked at point and nonpoint source LOT and Maximum Feasible LOT for the Eastern Shore as well as the Interim Bay Agreement and BNR/BNR equivalent reductions. Stakeholders did not support any of the these reduction scenarios because of the lack of specific local watershed information and the inability of the Water Quality Model to adequately portray local water quality conditions or problems. Therefore, the following discussion is included for informational purposes only.

LOT scenarios describe the upper boundary of what could be achieved given unlimited resources and application of BMPs on all land based on the "do everything, everywhere" idea. Therefore, the LOT nonpoint scenario estimates the maximum level of nonpoint source controls on urban and agricultural sources including maximum levels of urban BMPs, stormwater management, septic system controls, conservation tillage, nutrient management implementation, cover crops, forestry BMPs, and others. LOT includes 100 percent participation, unlimited cost share funding and unlimited resources. Appendix D includes the specific implementation scenario for LOT and Full Voluntary Implementation.

The Full Voluntary Implementation run describes the maximum feasible LOT, that is it recognizes some financial constraints and that land use application of BMPs is not universal. In general, the Full Voluntary Program Implementation scenario includes a maximum 75 percent cost share funding, and voluntary participation. The BNR/BNR Equivalent scenario considers the installation of denitrification in all point sources and comparable reductions in nitrogen for nonpoint sources and does not really consider reductions in phosphorus and sediment. The percentage reductions for the controllable portions of nitrogen, phosphorus and sediments for the Full Voluntary, BNR/BNR equivalent and LOT follows.

<u>Eastern Shore Point and Nonpoint Source Percentage Reductions</u>
Based on the 1985 Reference Loads

	BNR/Equivalent	Full Voluntary	LOT
Nitrogen Point Source	90%	94%	97%
Nitrogen Nonpoint Source	40%	41%	46%
Phosphorous Point Source	+716%	67%	99%
Phosphorus Nonpoint Source	25%	28%	50%
Sediment Nonpoint Source	3%	27%	51%

As the above table illustrates, the percentage reductions for nitrogen and phosphorus vary significantly between Full Voluntary/LOT and the BNR/BNR Equivalent scenarios. The results of the Interim Bay Agreement scenario were not broken out into point and nonpoint sources. Interim Bay Agreement reductions were a 34 percent reduction in nitrogen, a 33 percent reduction in phosphorus and a 27 percent reduction in sediment. These reductions are comparable to the overall reductions for the Full Voluntary (47% nitrogen, 34% phosphorus and 27% for sediment). The estimated costs associated with each scenario varied widely, possible to meet the interim 40 percent reduction for nonpoint and point source nitrogen, sediment and point source phosphorus under the maximum feasible LOT and under LOT. It should be noted that the LOT run is not cost-effective and using these projected reductions as a goal would not be practical. The stakeholders considered the interim Bay Agreement nutrient and sediment reductions as the goals for this strategy, but chose not to support nutrient and sediment reduction goals until better information is available.

Stakeholder and Basin Issues Identified by the Process

A number of policy and implementation issues were raised by stakeholders during the course of the assessment process. The resolution of these issues by state and local decision-makers, the General Assembly, and state and local program managers is expected to be critical to the long term success of a tributary strategy effort of this nature. A summary of these issues follows:

- Participants noted that urban nutrient management education was formally provided by the Extension Offices, but that funding priorities by the General Assembly effectively stopped these efforts. They noted that if priorities could be rearranged, then urban nutrient management education could resume and additional reductions would be possible.

- Stakeholders were interested in agricultural BMPs such as sediment ponds, as long as the water in these ponds could also be used for irrigation. Their concern was that the current design standards require such basins to be too shallow for irrigation. They further stated that an increase in the cost share for these facilities from 50/50 to 25/75 could increase the number of these facilities.

- Participants expressed an interest in an agricultural BMP program that would address sediment control and other issues associated with plasticulture operations as there are currently no such programs in place.

- The group also discussed the issue of fertilizer availability and the fact that distributors of fertilizer only provide one type of fertilizer for an area and that it often will cost more for a farmer to purchase a limited amount of fertilizer based on what is actually needed because of shipping costs for smaller amounts. They also discussed the need for fertilizer to be more precisely applied, using better application methods and machinery.

- Some group members noted that most highway and roadway ditches do not have grassed filter strips adjacent to them, but within the road's Right-of-Way. These members were of the opinion that if grass filter strips were established adjacent to roadways, then pollution in runoff from the adjacent lands would not enter the ditches which then empty into creeks and ultimately, the Chesapeake Bay.

- The stakeholders felt that the most important addition for nutrient and sediment reductions would be for an additional Water Quality Specialist to be hired to provide additional assistance in working with the agricultural community to track reduction activities that are ongoing but not counted and to provide additional assistance to those farmers who wish to implement additional agricultural BMPs but do not have the information or money available to do so. The numbers in the Year 2003 Reductions table reflects the increase in BMP implementation that the stakeholders believe is possible with the additional staff.

PART V. PLAN FOR REVISING THE EASTERN SHORE STRATEGY

GROUNDWATER MONITORING AND MODELING NEEDS

The influence of groundwater on the water quality of the local creeks on the Eastern Shore has not been discussed in this document because this document focuses on the introduction of pollutants through rainfall runoff. However, given the topography and hydrology of the Eastern Shore, the influence of groundwater both as a nutrient "storage" area and a nutrient transportation pathway to surface waters should be investigated in greater detail. A program to monitor and model the groundwater inflow to the surface waters of the creeks and the Bay should be developed in the future as a means of evaluating the effectiveness of long-term nutrient and sediment reduction efforts.

NUTRIENT AND SEDIMENT REDUCTION GOAL SETTING

As the previous section discussed, currently there are no established long term quantitative goals for meeting the living resource goal related to the restoration of SAV and establishment of beds further into the interior portions of the tidal creeks. Additional water quality monitoring and modeling data is needed to determine the conditions of the local creeks with respect to SAV parameters so that long term nutrient and sediment reduction goals can be set for the Eastern Shore's creeks. The focus of this *Eastern Shore Strategy* is on obtaining better water quality monitoring and modeling for the local Eastern Shore creeks. Once better data are available, the process for determining long term nutrient and sediment reduction goals can begin in earnest. Eastern Shore stakeholders will continue to be involved in this process.

Steps to Come: Where Do We Go From Here?

Since the research needs for the completion of a tributary strategy for the Eastern Shore are fairly comprehensive, the development of a goal will be dependent on obtaining better basin information. In this context, the *Eastern Shore Strategy* will be very much an ongoing process. This strategy represents only the first part of this process. The first step in this process was to familiarize ourselves with the characteristics of the basin, understand each stakeholders data and progress, assess the extent of these programs to the best of our ability, and project options for potential opportunities for additional nutrient reductions and resource needs. As such, this *Eastern Shore Strategy* represents an important step in developing a plan for improving water quality in the Eastern Shore basin that is based on sound science and supported by stakeholders. A number of future challenges remain before a long term nutrient and sediment reduction goal can be developed. This challenge is focused on two major tasks - nutrient and sediment reduction goal setting, and selecting specific action to meet the goal(s). In order to complete the strategy, and begin implementation as soon as possible, these two tasks will be undertaken concurrently once better water quality monitoring and modeling data are available.

Goal Setting

While the strategy development process in the Eastern Shore basin has not yet focused on setting long term quantitative goals for reducing pollutants to predetermined levels due to the lack of local water quality monitoring and modeling information, habitat objectives can serve as a starting point for this discussion, once it begins.

The Chesapeake Bay Program has developed several water quality objectives that will be used in the development of strategies for each of Virginia's tributaries. These objectives will provide the primary scientific context in which nutrient reduction goals for each of the tributaries will be established. These water quality objectives represent guideposts for improving, maintaining, and protecting the aquatic ecosystem habitat of the Chesapeake Bay and its tributaries. They depict the current best scientific understanding of the water conditions necessary for a balanced estuarine ecosystem, one that will support healthy aquatic life communities, including the bottom-dwelling benthic community and submerged aquatic vegetation (SAV). Details for the assessment and determination of these water quality objectives are provided in the Chesapeake Bay Program (1993), Dennison, *et al.* (1993), Batiuk *et al.* (1992), Jordan *et al.* (1992) and Funderburk *et al.* (1991).

The principal water quality parameters of interest are: dissolved oxygen (DO), dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), phytoplankton chlorophyll *a*, light attenuation coefficient (Kd), and total suspended solids (TSS).

Dissolved oxygen is a major factor affecting the survival, distribution, and productivity of living resources in the aquatic environment. Because of the natural fluctuations of DO, and the varied ability of the many key Bay species to tolerate less than desirable DO concentrations, habitat requirements for DO cannot be stated as a single, critical concentration. The sensitivity of each species to low DO depends upon life cycles, temperatures, salinity, duration of exposure, and other stress factors, such as contaminants. By selecting conditions acceptable for the reproduction, growth, and survival of a variety of sensitive species, habitat requirements can be established that will also protect the Bay's other living resources. Dissolved oxygen tolerance information was compiled and interpreted for fourteen target species of fish, molluscs, and crustaceans as reported in Funderburk *et al.* (1991), including both commercial and recreational fish and shellfish. The DO goals are summarized on the following page.

Summary of Dissolved Oxygen Goals[1]

Dissolved Oxygen Goal	Location & Other Specifications
At least 1.0 mg./l at all times	Throughout the Bay and tidal tributaries including subpycnocline waters.
Between 1.0-3.0 mg./l for less than 12 hours and interval between 1.0-3.0 mg./l longer than 48 hours	Throughout the Bay and tidal tributaries, including subpycnocline waters
Monthly mean of 5.0 mg./l or better at all times	All times throughout waters above the pycnocline
At least 5.0 mg./l at all times	Throughout the water above the pycnocline, spawning rivers, and nursery areas.

[1] See Chesapeake Bay Program (1993) and Jordan et al. (1992) for details.

Exposure to low dissolved oxygen (DO < 0.5-1.5 mg./l) concentrations have been found to be lethal, during some life stages, to all of the target species for which exposure information was available. While many species can live in waters with severely depressed (or hypoxic) dissolved oxygen conditions (between 1.5 and 3.0 mg./l) deleterious effects were found with growth and reproduction was severely compromised.

Submerged aquatic vegetation (SAV) refers to underwater vascular plants. This aquatic vegetation performs a number of valuable ecological roles in the Chesapeake Bay. The plants are a major food for waterfowl, and the beds provide habitat and shelter for a variety of fish, shellfish, and many smaller organisms which in turn serve as food for the variety of other larger organisms, many of which are valued commercial and recreational fishes. Historically, SAV has generally been abundant throughout the Chesapeake Bay; however, current populations are only a remnant of the once thick beds that provided shelter to the Bay's thriving fishery. The drastic decline of SAV, first noted in the 1970's, sparked the interests of the Bay scientists and managers to determine the cause for this significant loss and seek methods to restore this dwindling resource.

It is the general consensus of Bay scientists that the recent loss of SAV in the Chesapeake Bay is due to decreased light penetration throughout the water column and biofouling of plant surfaces caused by excessive loadings of nutrients and sediments from the watershed. Excessive nutrients and sediments cause increases in turbidity, therefore, limiting light necessary for the plants to grow and reproduce. Habitat requirements most applicable to SAV are those water quality parameters that directly measure or contribute to limiting light conditions, including: dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), total suspended solids (TSS), chlorophyll *a*, Secchi depth, and light attenuation (Kd). While light is the major parameter controlling SAV distribution, nutrients such as nitrogen and phosphorus, indirectly contribute to light attenuation by stimulating growth of algae in the water column and on the leaves and stems of SAV. Chlorophyll *a* is a measure of the amount of algal phytoplankton which contributes to decreased water clarity. Kd is a direct measure of water clarity. Together these parameters provide for both a qualitative and quantitative measure of the available light to the SAV community.

SAV habitat requirements are defined as the minimal water quality levels necessary for SAV survival. The diversity of their communities coupled with their wide salinity ranges, has led to the establishment of separate requirements based on salinity. Habitat requirements are provided for both 1 meter and 2 meter depths for restoration. The SAV habitat requirements provided below were developed by Bay scientists several years ago. A team of scientists is currently reviewing this list of habitat requirements. Their primary goal is to verify their pervious studies, refine the requirements as warranted and develop additional diagnostic tools that will help manage this important resource.

SAV Habitat Requirements

One Meter Restoration

Water Quality Parameter	Value	Other Specifications
Light Attenuation (Kd) (m-1)	<2.0	For TF[1,2] and OL [1,2] regions
	<1.5	For ME[1,2] and PO[1,3]
Total Suspended Solids (mg/l)	<15	For TF[2], OL[2], ME[2] regions and PO[3]
Chlorophyll a (μg/l)	<15	For TF[2], OL[2], ME[2] regions and PO3
Dissolved Inorganic Nitrogen	<0.15	For ME[2] regions and PO[3]
Dissolved Inorganic Phosphorus (mg/l)	<0.02	For TF[2] and OL[2] and PO[3]
	<0.01	For ME[2] and PO[3]
Two Meter Restoration		
light Attenuation (Kd)	<0.8	For TF[2], OL [2], ME[2] regions and PO[3]

[1]TF=Tidal Fresh (<0.5 ppt salinity), OL=Oligohaline (0.5 to 5.0 ppt salinity), ME=Mesohaline (5.0 to 18.0 ppt salinity) and PO=Polyhaline (>18.0 ppt salinity)
[2]Critical Life Period for SAV is April through October
[3]Critical Life Period for SAV is March through November

In order to provide an incremental measure of progress, the Chesapeake Bay Program established a tiered set of SAV distribution restoration targets. Each target represented expansions in SAV distributions that were anticipated in response to improvements in water quality. Tier I describes SAV restoration to areas currently or previously inhabited by SAV as mapped through regional and baywide aerial surveys from 1971 through 1990. Tier II is restoration of SAV to all shallow water areas delineated as existing or potential SAV habitat down to the one meter depth contour. Tier III is restoration of SAV to all shallow water areas delineated as existing or potential SAV habitat down to the two meter depth contour.

A number of environmental benefits are anticipated from reducing the input of excessive levels of nutrients that currently flow into Virginia's Bay tributaries. Among those benefits would be achieving the water quality objectives described above. The process of linking nutrient reduction to the resulting water quality conditions will be based on tributary specific water quality model simulations using the Chesapeake Bay Water Quality Model (WQM) and the Tidal Prism Model. Water Quality Model runs for tributary specific simulations were completed in early 1999 and the results of these runs were presented to stakeholders in March/April of 1999. The Water Quality Model results will be considered in conjunction with the results of the Tidal Prism Model to be the basic technical tools used to help determine the nutrient reduction goals for the *Eastern Shore Strategy*.

While the Tidal Prism Model can be used to evaluate the water quality of the creeks on the Eastern Shore, it will not provide specific information relative to the general SAV restoration goal that was expressed by the stakeholders. Therefore, additional modeling for SAV will be necessary in the future to determine whether the SAV goal can or is being met. In addition, future revisions of this document will need to discuss specific benchmarks that must be achieved to meet the SAV goal. These issues will be addressed in the future after better information on the water quality conditions of the creeks is obtained. The development of a numeric nutrient reduction goals to achieve the broad living resource goal will be a longer term process.

While not numeric goals per se, the results of the 2003 BMP targeting exercise will serve as a firm foundation for any nutrient or sediment goal that is developed. Stakeholders can go back to these targets and revise as necessary to address the final goal.

Selecting Actions to Reduce Nutrients and Sediments

The *Eastern Shore Strategy* must include actions recommended to meet the nutrient and sediment reduction goals once they are established. Much important background information has already been collected to help with this task through the assessment process. However, as the establishment of a long term nutrient and sediment reduction goal will not occur for several years, there are some tasks that will continue in the interim. The pollutant reduction options identified through the assessments to date should be refined and considered more thoroughly by stakeholders and the general public in the context of goal setting. The strategy must include more specific information on each selected action including a recommended level of implementation, expected pollutant reduction, cost, and circumstances under which each action will be implemented. Actions will be selected based on their practicability, equity, and cost effectiveness.

With the completion of a specific list of implementation actions to reach the pollutant reduction goals for the basin, a revised *Eastern Shore Strategy* will be made available for public input and for consideration by elected and appointed officials. After this review, the strategy will be modified based on comments received. The revised *Eastern Shore Strategy* will be a blueprint by which the Water Quality Improvement Fund grants can be targeted to reach basin pollutant reduction goals. It is anticipated that a revision to the Eastern Shore Coastal Basin Tributary Strategy will be undertaken in several years, beginning in 2003. The delay in the establishment of long term nutrient and sediment reduction goals is necessary to gather and analyze additional water quality information, from enhanced monitoring and modeling efforts outlined in earlier sections of this document.